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# Strategic Plan

# Focus on the Future

November 2012



University of Maryland  
CENTER FOR ENVIRONMENTAL SCIENCE



## Executive Summary

*Focus on the Future* is the strategic plan for the University of Maryland Center for Environmental Science (UMCES), intended as a touchstone for decision-making throughout the Center through 2018. UMCES is unique in its comprehensive mission to develop and apply “a predictive ecology” for Maryland through scientific discovery, integration, application and education. It is unusual in its distribution among four laboratories across the state. It is exceptional in its international reputation for the impact of its science. UMCES is: committed to scholarship that serves society, independent, engaged in effective partnerships, responsive to colleagues and clients, and egalitarian.

With its new partnership in the Institute of Marine and Environmental Technology expanding the work performed at the Appalachian Laboratory, Chesapeake Biological Laboratory, Horn Point Laboratory and Maryland Sea Grant College, UMCES has an revised mission that recognizes its leadership in graduate education in marine and environmental science. UMCES will contribute to the strategic themes of University System of Maryland (USM), including contributing to Maryland’s innovation economy, strengthening graduate and professional education, diversifying funding, and bolstering and sustaining national eminence.

UMCES must also respond to and take advantage of regional to international needs and opportunities for environmental science, including sustainability as an enduring theme, a new partnership in the National Socio-Economic Synthesis Center in Annapolis, the emerging National Ocean Policy, Maryland’s commitment to limiting the extent of and adapting to climate change, and a critical new phase for Chesapeake Bay restoration. And, it must do this in an era of public sector resource constraints.

The strategy involves building on the foundation of Center’s evolving strengths and course adjustments of the Strategic Directions chosen in the last plan, *From Vision to Reality*. Five topics for Future Focus for scientific discovery, integration and application are identified in the new strategy:

- **Genes to Ecosystems:** understand and apply genetic regulation of key ecological processes.
- **Human Welfare:** support resilient ecosystems and human health across the land-ocean continuum.
- **Energy Choices:** evaluate and communicate the environmental opportunities and consequences of energy production alternatives.
- **Water Security:** understand, evaluate and reduce the environmental consequences of the demand for water for agricultural, industrial and human use.

- **Global Reach:** enhance the capacity for international collaboration and training around the world to develop expertise in environmental research, application and management.

UMCES will and seek to attain accreditation for the award of graduate degrees jointly with the University of Maryland, College Park, and potentially with other USM institutions, and for the granting of course credits and certificates for professional education. It will also redouble its efforts in pre-college and life-long learning at the interface of environmental literacy and STEM (science, technology, engineering and mathematics) education.

Support of the UMCES mission in scientific discovery, integration, application and education requires ever more effective and efficient administration through a distributed network of responsibilities across the UMCES units, effectively tied together by best information technologies. Public communication and advancement efforts will be closely coordinated around the Future Focus topics in order to increase philanthropic support to cover at least three percent of annual operating revenues, particularly for faculty development and graduate education. Facilities renewal investments and major capital projects at each of the three laboratories managed by UMCES will focus on providing the modern and highly capable facilities needed to keep the Center competitive and a the leading edge of environmental science. Finally, UMCES is committed to being an exemplar in safe, responsible and sustainable facility design and operations.

## 1. Introduction

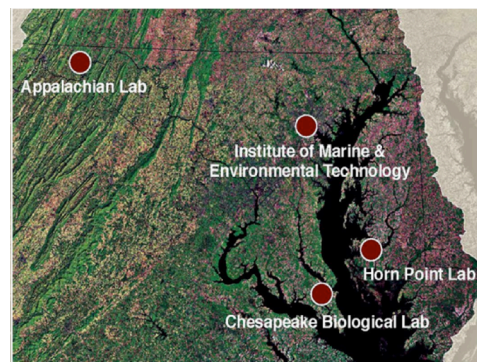
Since 1995, the development of the University of Maryland Center for Environmental Science (UMCES or the Center) has been guided by a series of three strategic plans, the most recent of which, *From Vision to Reality*, was completed at the end of 2004. Under these plans, UMCES has achieved substantial success, replenished its faculty and expanded its enterprises. Our continued development, coupled with changing external conditions, now requires a revision of the Strategic Plan to provide similar guidance over the next five to seven years.

*From Vision to Reality* was the result of in-depth self-study, client consultation and an external review and included many specific measurable outcomes. This new Strategic Plan, *Focus on the Future*, was developed through a more condensed process and is more focused in its orientation. We anticipate that the strategic directions developed in the previous plan are still largely appropriate, requiring refinement and refocusing rather than redirection. The new plan was developed collaboratively among the Center's senior leadership and faculty. We sought to produce a document that was brief, and readily understood and remembered, both internally and externally: one that could be used as a *touchstone for decision making* throughout UMCES into the future.

## 2. Mission and Core Values

As one of twelve institutions within the University System of Maryland (USM), UMCES operates under specific statutory mandates and a revised Mission Statement approved by the System's Board of Regents and the Maryland Higher Education Commission in early 2012. Its statutory mandate is to “conduct a comprehensive program to develop and apply a predictive ecology for Maryland to the improvement and preservation of the physical environment through a program of research, public service and education.”

In executing its mission through its four laboratories across Maryland, UMCES is a research, education, and service institution of the University System and a world leader in science of coastal environments and their watersheds. The Center advances knowledge through scientific discovery, integration, application and teaching that results in a comprehensive understanding of our environment and natural resources. Through collaborations with other System institutions, including the Maryland Sea Grant College that it administers, UMCES leads, coordinates, and catalyzes environmental research and education within the University System of Maryland.



By conducting cutting-edge research into today's most pressing environmental problems, UMCES is developing new ideas and solutions to help guide our state, nation, and world



toward a more environmentally sustainable future while making novel applications to develop and enhance new commercial enterprises. Training and inspiring the nation's next generation of environmental scientists is fundamental to our work.

The Center executes its mission while holding these **Core Values**:

- Commitment to environmental discovery, integration, application, and education that epitomizes our institutional responsibility to serve society.
- Adherence to the highest standards of academic independence in the pursuit of discovery and knowledge.
- Engagement in translational science in partnership with scientific colleagues, other units in the USM, agencies and stakeholders.
- Responsiveness to the needs of colleagues, sponsors, governments, and stakeholders.
- Maintenance of an atmosphere of egalitarianism with no barriers based on status and authority, enhancing shared governance and a commitment to diversity.

### 3. New Considerations

#### 3.1 Key Changes in Scope and Mission

Although the recently approved Mission Statement of UMCES is generally similar to its previous mission statements, it includes expansions in two important areas:

- **IMET.** The revised mission statement takes into account the new partnership among UMCES, the University of Maryland Baltimore County and the University of Maryland, Baltimore in the **Institute of Marine and Environmental Technology (IMET)**. IMET is being developed on the foundation of the former Center of Marine Biotechnology of the University of Maryland Biotechnology Institute, which was disaggregated in 2010. The IMET partnership brings into UMCES considerable expertise in molecular biology—complemented by the growing capabilities in that area at the other three UMCES laboratories—and a more explicit orientation within the UMCES mission of “promoting economic development related to biotechnology, environmental technologies, maritime commerce, natural products, energy, and natural resource utilization, with effective technology transfer, commercialization and business development.”



- **Graduate and Professional Education.** The revised mission statement also explicitly recognizes the importance of the leadership of UMCES in the University System of Maryland's nationally ranked graduate program in marine and environmental science, the

Marine-Estuarine-Environmental Sciences (MEES) Program. The revised mission includes a path for UMCES to seek accreditation to offer joint degrees with other USM partners and to assume an expanded role in graduate and professional education. With subsequent authorization by the Board of Regents, the process of accreditation for awarding joint degrees and professional courses and certificates has begun. This will require strengthening and sustaining commitment to graduate and professional education.

## 3.2 University System of Maryland Strategic Plan

# POWERING MARYLAND FORWARD

In December 2010, the USM Board of Regents approved a 10-year strategic plan, *Powering Maryland Forward*, with a focus on more degrees awarded, a stronger innovation economy and a higher quality of life for Marylanders. Its five themes are (1) helping the State of Maryland achieve its goal of 55 percent college completion; (2) ensuring Maryland's competitiveness in the innovation economy; (3) transforming the academic model to meet the higher education and leadership needs of Maryland's 21<sup>st</sup> century students, citizens, and businesses; (4) identifying new and more effective ways to build and leverage available resources; and (5) most importantly, achieving and sustaining national eminence through the quality of people, programs and facilities. UMCES is expected to contribute to these themes as related to its mission. For UMCES, this requires us to contribute to Maryland's innovation economy, strengthen our role in graduate and professional education, diversify our funding, and enhance our capabilities needed to bolster and sustain national eminence.

## 3.3 Science Needs and Opportunities

3.3.1 ***Sustainability as an enduring theme for environmental sciences.*** Sustainability involves meeting human needs equitably, without harm to the environment and without sacrificing the ability of future generations to meet their needs. Although sustainability was mentioned in several contexts in *From Vision to Reality*, this concept has become ever more prominent in science and in practice since 2004. The University System of Maryland created an Environmental Sustainability Initiative to foster instructional programs, "green" operations, and public policy support. The UMCES President serves as the responsible Vice Chancellor for this effort. Even the nation's basic research agency, the National Science Foundation (NSF), has advanced a Foundation-wide investment in Science, Engineering and Education for Sustainability (SEES) with the objective to inform the societal actions needed for environmental and economic sustainability and sustainable well-being. This NSF portfolio includes programs focusing on coastal and Arctic SEES, dimensions of biodiversity, climate change education, decadal and regional climate prediction, ocean acidification, sustainable energy pathways, and water sustainability and climate: all areas of interest and capability within the UMCES faculty. However, to compete effectively for funding related to sustainability, the UMCES faculty will have to expand research horizons toward problem solution and to collaborate more effectively with social scientists.

3.3.2 **SESYNC.** The University of Maryland, College Park, in collaboration with UMCES and Resources for the Future, a renowned institution dedicated to improving environmental and natural resource policymaking through objective social science, competed successfully among some of the nation's most prestigious universities for the NSF's new national center for synthesis in environmental sciences. The Socio-Environmental Synthesis Center (SESYNC) is now established in Annapolis, co-located with an UMCES office. SESYNC programs support the synthesis of natural and social science in addressing problems of the environment. Fostering fundamental, discovery-driven synthesis research that contributes to actionable science is central to SESYNC's mission. Clearly, this presents opportunities to participate in competitive SESYNC activities and for UMCES to expand its own synthetic activities, ranging from the regional to the international scale, that take advantage of the SESYNC collaborative model, its reputation, and its facilities.

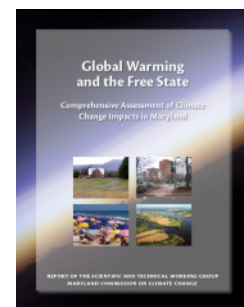


3.3.3 **National Ocean Policy.** In 2004, two national ocean commissions had recently completed major reports arguing for development of a comprehensive national ocean policy. Both the Bush and Obama administrations took steps to address these commissions' recommendations through better alignment of Federal executive branch activities. President Obama established a National Ocean Policy (NOP) by executive order, and an implementation plan was released in 2012 based around four major themes: (1) adopt ecosystem-based management; (2) obtain, use, and share the best science and data; (3) promote efficiency and collaboration; and (4) strengthen regional efforts. The scientific strengths of UMCES are well aligned with the priority objectives for implementing the National Ocean Policy. Already, UMCES scientists are playing a lead role in developing the international biological observatory recommended in the NOP implementation plan to assess changing conditions in the Arctic.

#### Priority Objectives of the National Ocean Policy Implementation Plan

- Ecosystem-Based Management
- Inform Decisions and Improve Understanding
- Observations, Mapping and Infrastructure
- Coordinate & Support
- Regional Ecosystem Protection & Restoration
- Resiliency & Adaptation to Climate Change & Ocean Acidification
- Water Quality & Sustainable Practices on Land
- Changing Conditions in the Arctic
- Coastal and Marine Spatial Planning

3.3.4 **Maryland Climate Action Plan.** *From Vision to Reality* categorized Regional Consequences of Climate Change and Variability as one of its four Strategic Directions. UMCES led the preparation of a comprehensive assessment of climate change impacts in Maryland, *Global Warming and the Free State*. This assessment was used by the Maryland Climate Change Commission in the development of the *Maryland Climate Action Plan* and now serves as the foundation for adaptation strategies being developed by the Commission. The *Maryland Climate*





*Action Plan* and associated legislation, particularly the Greenhouse Gas Reduction Act, places Maryland in the forefront among states in addressing the climate change challenge by limiting emissions and preparing for the changing climate. Clearly, understanding the regional consequences of climate change and climate variability remains important in order both to inform Maryland's response and to contribute to global scientific understanding.

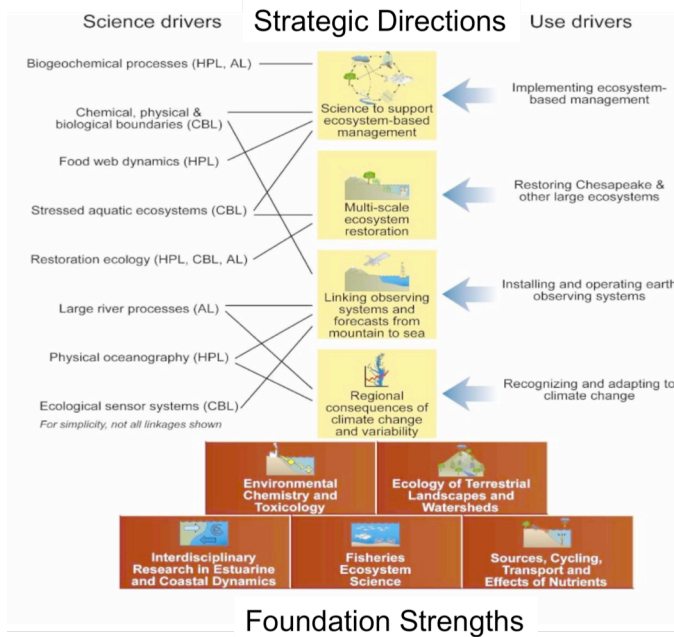
- 3.3.5 ***New phase for Chesapeake Bay restoration.*** Following the failure to meet its 2010 goals for reducing nutrient and sediment inputs into the Chesapeake estuary, the Chesapeake Bay Program has entered a new phase in its nearly 30-year history. This phase has mandatory requirements that the watershed states achieve the load reductions allocated under a Total Maximum Daily Load (TMDL). This requires incremental pollution reductions achieved by meeting two-year milestones as guided by specific Watershed Improvement Plans. While the technical basis for this approach is strong, challenges in implementation loom large, requiring additional science to: verify the effectiveness and efficiency of measures to reduce loads, quantify expected lags and trajectories in ecosystem responses, and integrate habitat restoration and living resource management with water quality improvement. As the premier environmental research institution within the Chesapeake watershed, UMCES has a particular responsibility to respond to these challenges.

### 3.4 Resource Constraints

While the *From Vision to Reality* strategy was not based on an assumption of significantly increasing state appropriations, neither did it anticipate the significant constraints on state support that have occurred, the related restrictions in the ability of UMCES to increase faculty and staff salaries based on merit and the draw downs on fund balances. At the same time grant and contract awards grew from \$18 million in FY 2007 to more than \$27 million in FY 2010, when UMCES received significant funding as a result of the American Recovery and Reinvestment Act. Awards averaged \$23.5 million during the last two fiscal years. Even as the economy slowly improves, increases in state appropriations for UMCES for programmatic expansion will be limited at best over the next several years. Even if the University System is granted the authority to amend salaries in order to regain competitiveness, these may have to be funded from existing resources.

Declining state support for public universities has occurred throughout the nation and most institutions are struggling to generate resources from other sources. The University System of Maryland Strategic Plan requires UMCES and its sister institutions to develop more effective ways to build and leverage available resources. As tuition revenue is not a major funding source, UMCES cannot do this simply by raising tuition rates, but must maintain and stimulate growth in facility and administrative cost recoveries from sponsored research, develop partnerships with private organizations or government agencies, and redouble efforts to attract unrestricted philanthropic support.

## 4. Foundation Strengths and Strategic Directions



*From Vision to Reality* defined four Strategic Directions intended to guide and focus the Center's efforts in research, education and public service. These were selected and formulated based on Foundation Strengths within the UMCES faculty, coupled with assessment of the principal science drivers ("What are the most interesting and important questions for the advancement of science?") and use drivers ("What are the most critical information needs by society?"). Here we ask: "How have the Foundation Strengths changed? What has been achieved within the Strategic Directions? Are these directions still priorities and how might they have changed since this last strategic plan?"

### 4.1 Evolving Foundation Strengths

The five areas previously identified as Foundation Strengths remain as strong or stronger, with Environmental Chemistry and Toxicology having gone through a rebuilding phase. To these Foundation Strengths we now add **Environmental Molecular Biology**, resulting not only from the addition of a complement of internationally recognized faculty members at the Institute of Marine and Environmental Technology, but also the recruitment of faculty in ecological genomics and microbial ecology at the other UMCES laboratories.

### 4.2 Strategic Course Adjustments

The Strategic Directions have been used to guide faculty recruitment and other investments, to focus skills and resources, and to represent and market the competitive capabilities of UMCES. Considerable progress has been made towards the ambitious milestones laid out in *From Vision to Reality* and significant accomplishments have been realized in all four Strategic Directions. However, more remains to be done.

4.2.1 ***Science to support ecosystem-based management.*** Effective ecosystem-based management demands integration of knowledge and information from a broad range of disciplines to yield a mechanistic and predictive understanding of how ecosystems respond to human actions. Response of the Chesapeake Bay ecosystem to nutrient load reductions under the new TMDL regulations is a prime example. UMCES has continued to integrate science in ways that can inform ecosystem-based policies and

decisions, yet management organizations still struggle with this approach. UMCES can help advance ecosystem-based management within the Chesapeake watershed and beyond through promoting: (1) innovation in whole ecosystem science, (2) integration of environmental and social science, and (3) applications centered on principles of transparency, stakeholder engagement, adaptive management, and the precautionary approach.

- 4.2.2 ***Multi-scale ecosystem restoration.*** “Smart restoration” must be well-integrated with preventative measures and based on science that supports realistic goals for the rehabilitation of ecosystem services. UMCES continues to be centrally engaged in scientific research and application related to restoration of forests, streams, wetlands, oyster reefs, and harbors. The greatly expanded productivity of its shellfish cultivation facility has empowered Maryland’s new oyster restoration and aquaculture program. New strengths in molecular genetics can contribute significantly to the design of effective ecosystem restoration strategies. More attention is required to evaluate how individual restoration projects, which are typically small-scale, confer aggregate benefits to fish, wildlife, people and the ecosystems upon which they depend.
- 4.2.3 ***Linking observing systems and forecasts from mountain to sea.*** Technological advances are providing unprecedented in-place and remote observations that can be coupled with ongoing analysis and modeling to enhance predictive capabilities. This coupling is synergistic, with observations serving as a basis for refining models and models used to interpret and improve observations. While UMCES was not able to rise to the leadership position in regional observation networks (e.g., MARA and MAREO) to the degree proposed in the plan, it is mainly because these systems have not developed as rapidly as it seemed they might. Nonetheless, UMCES is engaged in the Mid-Atlantic Regional Association for Coastal Ocean Observing Systems. It remains centrally involved in the Integrated Ocean Observing System more broadly through involvement of its Alliance for Coastal Technologies that tests and verifies sensors deployed in the System. UMCES was recently awarded a NSF Major Research Instrumentation award for an unmanned autonomous underwater vehicle (Remus 600) for innovative observations of the Chesapeake Bay and Atlantic coastal waters. Moreover, UMCES scientists have produced innovative and influential analyses of observational data (e.g., remote sensing and monitoring data from the Chesapeake Bay Program) and have provided regional and national leadership in the development of ecological forecasting models. Strategic opportunities exist for improving the linkages between observations and forecasts for the Chesapeake estuary and watershed.
- 4.2.4 ***Regional consequences of climate change and variability.*** The consequences of global climate change and its effects on climate variability will have to be addressed on local to regional scales. Since the last strategic plan, UMCES scientists have produced important syntheses of the impacts of regional-scale climate variation in the Arctic and for Maryland and the Chesapeake Bay. The 70-year long temperature series measured daily at the Chesapeake Biological Laboratory of UMCES presents

compelling evidence for 20<sup>th</sup> century warming in the Chesapeake Bay. These synthesis efforts provide the foundation for future research and applications to climate adaptation strategies. New faculty members have strengthened UMCES capabilities in the area of ecosystem response to climate change, including the collection and interpretation of paleo-ecological data and the use and interpretation of climate models. With this new expertise and with climate change issues becoming ever-more prominent and pervasive, activities relevant to this theme are likely to grow substantially.

### 4.3 Science Integration and Application



The Integration and Application Network (IAN) has evolved as a regionally, nationally and internationally prominent resource for more effective science communication for ecosystem protection, restoration and management. In its ten years of existence, IAN has produced over 300 science communication products (including 12 books, 67 newsletters, 41 report cards) and trained over 500 scientists in science communication.

The IAN website is heavily utilized, with over 100 million graphic symbols downloaded by users from 235 countries. The IAN business model has proven to be viable, with a diverse funding base and multiple partners. IAN science communicators, integrators, analysts and interns have provided leadership in Chesapeake Bay region and beyond, both while on the staff and subsequently. IAN has had an active role in key environmental issues such as climate change, marine protected areas, and ecosystem restoration. IAN has leveraged local experiences with these issues to advance science applications for such iconic ecosystems as the Great Barrier Reef, Gulf of Mexico, and Pacific Island nations, thereby increasing the global footprint and visibility of UMCES.

IAN will continue to catalyze and empower synthesis of scientific understanding and its application in advancing more effective environmental stewardship. In the process it will contribute to the themes of the USM Strategic Plan, such as competitiveness in the innovation economy, transformed academic models, building and leveraging resources and national eminence, while in a manner consistent with UMCES Core Values. Strategic collaborations will be developed with SESYNC and new technologies will be employed in scientific integration and communication. IAN will effectively and efficiently engage the expertise of the UMCES faculty, recognizing and respecting that science integration and application are essential elements of scholarship that extend throughout the Center's mission.

## 5. Future Focus in Discovery, Integration and Application

During and following the 2012 UMCES Faculty Convocation, five topics of Future Focus were identified and developed. These foci were recognized as nascent and distinct elements related to the Strategic Directions in *From Vision to Reality*. These topics were motivated by the institution's recently developed and expanded scientific capacity, emerging societal needs, or funding opportunities. As mentioned above, these Future Foci are intended to amend and channel the Strategic Directions rather than supplant them.

## 5.1 Genes to Ecosystems

*Understand and apply genetic regulation of key ecological processes.*



An emerging new research frontier focuses on understanding how genetic variation influences organisms, populations, communities and ecosystems and specifically the connections between genetics, gene regulation, species diversity, and ecological and biogeochemical processes. Changes in the genetic composition of foundation species and in gene-environment interactions are becoming more prevalent as a result of biological invasions, anthropogenic pollution, climate warming, and other manifestations of environmental change. These genetic changes have the potential to cascade through interacting systems to affect population viability, community organization, and the flow of nutrients and energy through ecosystems. With newly developed molecular tools and approaches, genetic regulation of key ecological processes can now be elucidated at unprecedented levels of resolution, and in nearly every study system. This interdisciplinary focus brings together researchers with expertise in molecular biology, population and community ecology, fisheries and wildlife science, and biogeochemistry. Their research will have the capacity to identify important connections between diversity and function at various levels of organization from the genetic and genomic level through populations, communities, and ecosystems, allowing assessment of ecosystem functioning and resilience. The merging knowledge also has significant potential for commercialization for uses ranging from waste remediation to drugs and biofuels.

*Action:* By 2015, develop and initiate three large cross-laboratory research programs, taking advantage of strengths exhibited by the evolving UMCES faculty. Genes to ecosystems approaches can be applied to many of the most pressing environmental problems we currently face, including how forest trees will adapt to climate changes; how genetic diversity of the multiple populations of microbes (metagenomics) interacts with ecosystem function, aquatic pollution and eutrophication; and how the rapid evolution of resistance traits affects the ecological impacts of emerging pathogens and invasive species.

## 5.2 Human Welfare

*Support resilient ecosystems and human health across the land-ocean continuum.*



The vast majority of the world's population is located along the coast and within coastal watersheds. With greater use of marine and coastal resources and global environmental changes (including climate, sea level, and acidification) concern is growing that human welfare will be greatly impacted, particularly in populous and vulnerable coastal environments. Toxicants and water-borne diseases may affect humans directly and impact economically or ecologically important species on which humans depend. On the other hand, the marine environment is also a promising source of new bioactive compounds that can be developed into pharmaceutical products. UMCES science has effectively focused on the health of ecosystems and living resources, paving the way for future



attention on the causes, impacts, and mitigation strategies that minimize the risks to humans. The economic welfare of rural coastal communities in Maryland is largely dependent on healthy ecosystems and sustainable fisheries and aquaculture. The economic viability of the Port of Baltimore, and other ports around the world, is dependent on protecting human welfare by minimizing the risk of introduction of diseases and other invasive species and the quality of life of adjacent communities. The UMCES faculty is eminently qualified to address this Future Focus through the study of sustainable fisheries management and, through the Maritime Environmental Resource Center, environmentally compatible port operations. These include understanding and managing emerging threats, such as from climate change and sea level rise.

*Action:* Conduct broad-scale research programs that include collaborators, including other USM institutions, in the areas of medical research, anthropology, sociology, and economics. Strategically add faculty members capable of bridging the social and biomedical sciences in the area of human welfare.

### 5.3 Energy Choices

*Evaluate and communicate the environmental opportunities and consequences of energy production alternatives.*



Numerous new and alternative sources of energy are being pursued for development and implementation, such as biofuels, wind turbines and solar farms, natural gas production from shale through hydraulic fracturing (fracking), fluidized-bed coal combustion, advanced nuclear reactors, oil drilling deep offshore, and new battery technologies for hybrid and electric vehicles. Society is being faced with a number of energy choices that should be informed by knowledge of the environmental, societal, and economic consequences of these activities encompassing, for example, sustainability of energy supplies, climate change, habitat fragmentation, pollution of surface and ground waters, atmospheric emission of gases and particulates, erosion and sediment transport, endangered or invasive species, waste disposal, and the remediation and reclamation of abandoned sites. These provide new challenges and opportunities for biotechnologists, landscape and population ecologists, geologists and geochemists, climate and atmospheric scientists, hydrologists, toxicologists, and environmental economists, all of which are represented on the UMCES faculty.

*Action:* Develop new research programs related to the impacts of energy exploration and use, particularly as they relate to new or problematic methods of fossil fuel extraction (e.g., shale fracturing, deepwater drilling), as well as renewable energy (e.g., wind and biofuels).

## 5.4 Water Security

*Understand, evaluate and reduce the environmental consequences of the demand for water for agricultural, industrial and human use.*



Population demands for reliable water supplies are likely to increase given ongoing climate and land use changes that influence the quantity and quality of fresh water supplies. These concerns go beyond issues of civil engineering, considering societal impacts on the quality of water available both for human use and to sustain important ecosystem services. Water security is defined as an acceptable level of water-related risks to humans and ecosystems, coupled with the availability of water of sufficient quantity and quality to support livelihoods, national security, human health and ecosystem services. UMCES possesses the scientific skills to address important issues related to water security that include, but are not limited to: impacts of changes in hydrology on ecosystem structure and resilience; effects of water withdrawal, waste water and septic system discharge on water quality; consequences of changes in hydrographs on ecosystem productivity; forecasts of structural and functional ecosystem responses to changes in water diversions and dams; and integrated real time monitoring of water quality. Research and assessment to address these issues is inherently multi-disciplinary and would likely lead to increased collaboration among UMCES laboratories, forging new partnerships and collaborations.

*Action 1:* Strategically broaden expertise in key areas related to hydrology and water resources to strengthen our abilities in hydrologic modeling and research that are responsive to societal needs.

*Action 2:* Develop large-scale research programs with collaborators that study the impacts of growth and development patterns on water availability, quality and use; wastewater discharge and impact to receiving waters; and large-scale hydrology. Building on previous efforts, the Potomac watershed and estuary should receive priority for collaborative studies within the Center.

## 5.5 Global Reach

*Enhance the capacity for international collaboration and training around the world to develop expertise in environmental research, application and management.*



UMCES scientists are engaged in collaborative research and science application around the world. These activities enhance environmental science and its applications here in Maryland, and likewise help extend our highly regarded accomplishments in the Chesapeake region to other regions of the world. UMCES should extend its global reach by building on its relationships and reputation in a more organized way, both to provide assistance to other regions of the world working to address similar challenges, and to develop new markets for the Center's research and

educational services. UMCES has the potential to build strong institutional partnerships around the world, leading toward robust expert and student exchanges and instructional programs.

*Action:* Establish an International Coastal and Watershed Science Institute to market, develop and manage international collaboration and training. The Institute will provide the organizational capacity to facilitate exchanges of researchers, graduate students and environmental managers, as well as the delivery of professional instruction. It will be a virtual institute, not confined to one location, but will be staffed and supported by external sources of funding, including philanthropy and service fees. The Institute would build from a base of existing international relationships (e.g., with Baltic nations, China, India, Korea and Brazil).

## 6. Future Focus in Education

### 6.1 Higher Education and the Workforce

UMCES will continue to concentrate primarily on graduate and professional education, but will contribute to undergraduate education through internships (e.g. research experiences for undergraduates) and undergraduate instruction, where feasible and effective, such as through winter and summer term courses. The Center will, in particular, seek to engage students from groups under-represented in the environmental sciences, such as through sustaining its participation in the Living Marine Resources Cooperative Science Center, a minority training partnership supported by the National Oceanic and Atmospheric Administration.



The Board of Regents has authorized UMCES to seek accreditation for the award of joint graduate degrees in the Marine-Estuarine-Environmental Sciences (MEES) Program. This is an important milestone in the history of UMCES; however, the promise this offers both for UMCES and this important USM graduate program depends on attaining accreditation and developing a powerful enabling agreement to operate a joint program with our most significant historical partner, the University of Maryland, College Park.

In addition, as endorsed by the Regents, accreditation would enable UMCES to offer professional development courses for credit and certificates. In doing so, UMCES can serve an important and underserved market, thereby contributing to the development of Maryland's workforce and strengthening relationships with private and public sector employers. The capacity for instruction related to professional development is also critical to achieving the objectives of the Global Reach focus (Section 5.5).

*Actions:* UMCES will aggressively act to take full advantage of this potential new authority through taking the following actions: By November 2012, complete an effective agreement on the scope, administration and operation of a joint degree program with the University of

Maryland, College Park. By September 2013, begin curriculum and other reforms to the MEES program, as well as develop courses for professional and certificate programs. Appoint a highly competent academic administrator to serve as the Vice President for Education. By September 2014, begin implementation of the joint degree program.

## 6.2 Pre-College and Lifelong Learning

UMCES will continue the strategic approaches developed in *From Vision to Reality* for its environmental science education programs oriented to public and K-12 audiences. The overall goal is to improve understanding by the public and students of local, regional and global environmental issues, as well as the scientific practices used to examine and address these issues. These outreach programs will build on UMCES scientific endeavors and include designing, developing and implementing materials, and assessing impacts on participants.



Formal, in-school education efforts, including those in Maryland Sea Grant, will maintain a strong focus on teacher professional development and will seek ways to incorporate contemporary environmental science content in the adoption of Next Generation Science Standards and Environmental Literacy Requirements in schools in Maryland and beyond. In this way, UMCES will contribute to STEM (science, technology, engineering and mathematics) education objectives that are a critical element of the USM goal of ensuring Maryland's competitiveness in the innovation economy.

Informal, out-of-school education will continue to be promoted through open-house events, public presentations by UMCES scientists, and the UMCES website. This outreach to public audiences will be expanded to include comprehensive education efforts (e.g., citizen science projects or collaborations with informal education institutions); social networking; a new open service through which UMCES faculty members will provide an objective scientific perspective on timely issues; and short courses for governmental officials and managers. UMCES education researchers and specialists will continue to work with the Center's scientists to develop and support these efforts by obtaining competitive science and education funding. Overall, UMCES will provide information, engage K-12 and public audiences, and manage news media interactions in a manner that establishes our scientific experts as reliable and articulate authorities.

## 7. Support Requirements

### 7.1 Effective and Efficient Administration

The administrative units within the distributed laboratories and Center Administration work cooperatively to facilitate the budgeting, business processes, financial services, and efficient facilities management and planning required to support the UMCES mission, while

continually seeking greater effectiveness and efficiency. With geographically dispersed locations throughout the state, each unit has local responsibility for physical plant operations with only general overall coordination in Center Administration. Many administrative services, such as procurement and travel reimbursement, are provided by the University of Maryland, College Park. UMCES continues to expand arrangements with USM institutions, such as for administrative services at IMET and technology transfer services, both with the University of Maryland Baltimore County.

Since 2004, growth in sponsored projects has been strong with indirect cost recoveries providing critical support for laboratory operations. However, growing grant regulations and compliance have increased administrative burdens at both faculty and administration levels. This creates an on-going challenge of meeting requirements while minimizing administrative costs. The data management and quality assurance plans that have been put in place or are under development, both institution-wide as well as project-specific, are examples of responses to address more stringent requirements. Since 2008, effective reductions in state operating budget support have constrained administrative support throughout UMCES, creating an even greater challenge for responsive and accountable management.

An internal administrative review among business administrators across UMCES was conducted in 2009. Functions in all units and best practices among them were explored and have been more broadly adopted. This process continues through the use of new technologies and shared positions among units where appropriate. These efforts also support the Board of Regents effectiveness and efficiency requirements.

As UMCES expands its Global Reach, processes and tools should be developed to facilitate all types of international exchanges and agreements. This would include maintaining visa facilitation programs, creating model agreements and ensuring that export control requirements are addressed.

With UMCES accreditation, administrative support for the course offerings and certificates will need to be developed and managed in the most cost effective manner to maximize potential revenues.

## **7.2 Resource Development**

At its roots, scientific research and education within UMCES seeks to secure a healthy and vibrant environment for Maryland and beyond—bolstering the quality of life and supporting desirable locations to live, work, and recreate. Our advancement and communications efforts must reflect this positive and resonant principle.

The funding environment for UMCES, like other universities, is tightening. State funding continues to decline. Sustaining, much less expanding, sponsored-research funding will likely be challenging as the Federal deficit and budgetary pressures mount. In addition, the competition for philanthropic dollars is intense. In 2011, environmental and animal welfare groups captured less than three percent of the \$298 billion contributed to nonprofits in the United States. The majority of this went to large, national and international non-



governmental organizations (e.g., the Nature Conservancy, Environmental Defense Fund, World Wildlife Fund, etc.), mainly for policy and advocacy efforts.

As the philanthropic pool for marine and environmental science research and education is relatively shallow and already crowded, our efforts to compete for these funds must be strategically focused. Support for objective, science-based analysis to inform decision making should be attractive to donors interested in effective and efficient environmental outcomes. The Future Focus areas of genomics, human welfare, energy choices and water security are core priorities for major corporations as well as major philanthropic foundations and lend themselves well to commercial and programmatic partnerships addressing common public and economic interests.

Private philanthropy currently represents less than one percent of the annual \$45 million of revenues within UMCES. This amount must increase to at least three percent by 2018 (sustained funding of \$1.3 million annually) to make a modestly significant contribution to the overall enterprise, and then to increase to at least five percent in ten years (\$2.3 million on a sustained basis). To achieve this goal fundraising actions will include:

- Developing a consensus for funding priorities among the leadership, faculty, and Board of Visitors of UMCES and existing funders. This will likely require formal campaign interviews with a cross-section of these constituencies, even as we complete the existing USM federated campaign (\$8 million for UMCES).
- Launching a new campaign in conjunction with other USM institutions—the funding targets and duration are to be determined.
- Raising \$1.3 million in philanthropic support annually by 2018 (measured as a moving three-year average).
- Growing endowment resources five-fold—from its current level of \$1 million to at least \$5 million by 2018.
- Developing a pool of at least 200 prospective major gift donors (potential donors capable of \$25,000+ gifts over five years). This will require targeted cultivation by the Center's leadership, laboratory directors and Visitors in specific locations with constituents we determine to have: (a) an interest in the environment and the Chesapeake Bay watershed, in particular; (b) the available means to make significant gifts; and c) an interest in promoting opportunities for discovery, application and graduate education in marine and environmental science.
- Formulating potential commercial partnerships in areas coinciding with key strategic priorities.

Prospective focus areas for fund raising that are both areas of UMCES strength and donor interest include the following themes:

- ***Chesapeake Bay restoration:*** research and education as a model for estuarine research nationally and globally. The critical role UMCES plays in achieving and sustaining Chesapeake Bay restoration resonates with the public and donors. Articulated

effectively, the global reach of our science reinforces this regional leadership role, and vice versa.

- **Energy Choices:** development of algal biofuels; natural gas development best practices; carbon monitoring and alternatives; climate change modeling with an eye to protecting critical infrastructure and community and corporate interests.
- **Environmental health:** ocean and river quality; research on water-borne pathogens; harmful algal bloom impacts on fish and people; river and stream health in rural communities.
- **Innovations in sustainable fisheries:** fisheries management; building consensus among diverse stakeholders; alternative fish feeds and aquaculture technologies; support of seafood industry.
- **Economic development:**
  - support the Port of Baltimore with dredged material placement and reuse, ballast water management, emissions, contaminant remediation and community redevelopment;
  - evaluate and seek to maintain the economic vitality of ecosystem services, emphasizing the linkages among land use, the quality of water resources, quality of life and recreation and tourism;
  - work constructively with the fishing industry on regulatory guidance, business plan development, yield predictions and more; and
  - advise the corporate community on sustainability issues, energy efficiency and environmental stewardship to strengthen corporate competitiveness in hiring and retaining employees who care about the environmental quality of their communities.
- **Faculty development:** completion of endowment of the France-Merrick Professor of Sustainable Ecosystem Restoration and initiation of endowments and quasi-endowments to support the scholarship of outstanding faculty members.
- **Graduate education:** fellowships to enhance competitiveness for superior graduate students.

Advancement cannot be successful without creative alignment with our communications, marketing, public awareness and media relations efforts. Accordingly, the Advancement and Communications programs must work closely together to address mutual needs and objectives. Communications activities must raise the awareness of the value of our work among those with the ability to support it. Conversely, philanthropic support can help raise the UMCES public profile.

Finding solutions to critical environmental challenges requires working across political, geographic and constituent boundaries. Solutions that will require large philanthropic investments can be fostered by innovative collaborations with non-governmental organizations, as well as interdisciplinary approaches involving economists, business groups, engineers, policy makers, public health officials and others. UMCES will focus intensely on

collaboration with individuals and institutions with an interest in innovative solutions founded on exceptional science.

### 7.3 Modern and Highly Capable Facilities

UMCES facilities have consistently improved since *From Vision to Reality*. Since 2004, facilities have expanded at the Horn Point Laboratory (HPL) with the Oyster Cultivation Pier, an upgraded replacement Environmental Information Center and a small Level II Bio-Safety Lab. At Chesapeake Biological Laboratory (CBL), facilities were expanded with the Truitt Extension, but then were reduced by the need to close the original Truitt Laboratory due to irreparable building deficiencies. A replacement is currently in the planning phase. The CBL Research Pier, which has been closed for a few years, is currently undergoing a major renovation with support from the National Science Foundation.

In 2008, the aging Chesapeake Bay research vessel *Aquarius* was successfully replaced. Christened in November 2008, the R/V *Rachel Carson* is now the flagship of the UMCES research fleet. This 81-foot state-of-the-art vessel can be rigged to support a wide variety of estuarine and near-coastal oceanographic research projects, including dredging, trawling, coring, water quality observations, plankton sampling, and observing system buoy deployment. The Rachel Carson provides regional scientists with a tool for assessing the waters of the nation's largest estuary. This highly capable research vessel will support us well in our Focus on the Future.



In addition, a unique Mobile Test Platform, a 155-foot barge, was put into service in September 2011. This research platform will be used to provide ballast water treatment test facilities, expertise, information, and decision tools to address key environmental issues facing the international maritime industry.



Our *Facilities Master Plan for 2012-2022* has just been finalized. It provides a snapshot of where we are today, as well as a planning tool in support of our vision, which fully and broadly includes sustainable operations. As a flexible framework, it

enables UMCES to respond to the goals of this Strategic Plan and any resulting programmatic changes, as well as changes driven by technology in support of research and education facilities.

Capital projects listed in the UMCES 2012-2022 decadal master plan include an Information and Communications building at the Chesapeake Biological Laboratory, a Coastal Dynamics Laboratory and a major renovation and addition to the Morris Marine Laboratory at the Horn Point Laboratory, and a building addition and field laboratory at the Appalachian Laboratory.

Annual funding for facility renewal projects began in 2007 and has provided funding for overdue renovations at a number of older facilities. This fund has not been able to grow at the intended rate set by our Board of Regents, resulting in a continual challenge of renovating the high percentage of UMCES facilities that are more than 25-years old. Continued renovations to ensure that our facilities remain well suited for modern research will remain a high priority over the next decade.

#### 7.4 Safe, Responsible and Sustainable Operations

UMCES is committed to safe, responsible and sustainable facility design and operations, including in its capital and facility renewal projects and practices in four major sectors: (1) greenhouse gas reductions, (2) storm water management and domestic water conservation, (3) resource conservation, and (4) education, civic engagement and communication.



A prominent and far-reaching requirement is the fulfillment of the American College and University Presidents Climate Commitment (ACUPCC), signed by President Boesch in December 2007, to achieve carbon neutrality. Toward this end efforts are guided by the

UMCES Climate Action Plan. Related efforts within the 2012-2022 Facilities Master Plan focus on both retrofitting existing facilities with more energy efficient systems as well as using new projects to raise the bar even higher with the more comprehensive opportunities that new projects afford. Campus energy infrastructure projects through utility partnerships also provide a benefit to the institution and the state through reduced operating costs.

The planning principles in place to guide the physical development of facilities will incorporate sustainable design, no longer as a separate matter, but fully integrated in the planning and design process. While State and University System policies require that new construction and major renovations achieve LEED Silver as the minimum certification level, UMCES will strive for LEED Gold certification and a minimum of 35 percent energy savings over the current energy code compliant standards. Safety and accessibility by people with disabilities are included as integral components of the planning and design of buildings and site improvements (i.e. parking, roads, walks, landscaping).

Operations must include a commitment to ensuring the safety and security of UMCES employees, visitors and those entrusted to our care, the animals used in our research, and the environment around us. This is assured through a number of compliance programs, including Institutional Animal Care and Use that ensures appropriate humane care and use of vertebrate animals in our laboratories and field research. Through a memorandum of understanding with the University of Maryland, College Park, an Institutional Review Board will continue to approve our use of human subjects in survey or other research.



Other programs and services in place must cover the full range of matters such as diving safety, biosafety, radiation safety and occupational and environmental health and safety. Employee health and protections matters include adherence to new USM policies concerning the reporting of suspected child abuse and neglect. The primary responsibility for laboratory and environmental health and safety will continue to be held at the laboratory level with overall coordination at Center Administration. In the case of IMET, the partner institutions (UMBC and UMB) have assumed some of these responsibilities. The systems recently put in place for distributing critical, time-sensitive information to employees at a laboratory or throughout UMCES will be regularly exercised and continually improved.